Development and application of geographical methods in aquaculture

Introduction

Geographical Information Systems (GIS) are computer systems used for capturing, storing, checking, and displaying data related to positions on the Earth's surface [1]. GIS field rapidly evolved in the late 80s and started providing important tools to any of those disciplines handling and exploiting data related to geographical locations [2]. As it was a new sophisticated technology, allowing new implementations to accomplish more in less time, GIS was then deployed in many other contexts and by many stakeholders [3]. GIS has been used on a progressively larger scale also in veterinary medicine for purposes such as conducting epidemiological investigations (e.g., recording and reporting disease information, making epidemiological data analyses and models) and for disease monitoring and surveillance (e.g., planning disease control strategies, early warning, and as a decision support system) [4][5][6]. Despite the fact that, to date, GIS is still considered a powerful tool to be applied in veterinary medicine for studying and modelling animal diseases [7], in aquaculture its use is still limited. In fact, their main applications fall within mapping disease risk areas and spatiotemporal tracking of disease outbreaks and spread, especially in highly-intensive aquaculture systems and for highly-valued food products [8]. GIS technologies are employed especially in research activities, for visual delineation of disease areas, and to track interactions between fish populations or between fish and the environmental biota, rather than to implement risk factor analyses and model disease spreading in actual on-field surveillance programmes. Operative research seems to have failed in the promotion of GIS analyses as means to interlink fish health, farmed and wild populations, and environmental data. Such analyses would, indeed, provide a valuable support to prevent and control disease spreading as they are based on real-time environmental and epidemiological inputs from widely-covering geospatial remote sensing.

New and exciting opportunities have been offered to model GIS applications towards an integrated approach. Among others, rapid advancements in hardware and software, greater availability of remote sensed data, potential contributions from individuals as data providers, and innovative methods to organise, analyse, and present data. Usually, GIS applications are categorised based on the objectives and perspectives we want to adopt (e.g., technological vs. organisational). For use in veterinary medicine, more traditional classification methods (i.e., by Tomlison [9], Longley [10], URISA [11]) seem to be too GIS-focused. Moreover, veterinarians use GIS only as a means to obtain maps or lists of data. Therefore, paying too much attention to the technological and organizational aspects could be counter-productive, and we should focus on the new and specific opportunities and benefits that GIS brings to the discipline, especially in aquaculture. Indeed, when implemented for veterinary purposes, GIS applications usually fall within the entry categories of the traditional classification methods (e.g., "one-time-effort" by Tomlison, "GIS as a tool" by Longley, "Level 1 – Ad hoc (chaotic) processes" by URISA). Therefore, it would be useful to develop a new and tailored classification method; one that is based on the abovementioned classifications but modified to meet the specific needs of the veterinary and, namely, aquaculture sectors.

The development of such integrated models requires the availability of a specific body of knowledge, including a list of best practices, SDIs and data sources that could be adopted in the aquaculture sector (satellite data, rivers, etc.). Additionally, it requires specific functions and libraries for data analysis that are not usually included in the most used GIS software.

The experts' consultation we are holding aims at fostering the development of such body of knowledge and the application of GIS in the field of epidemiology, surveillance and disease control in the aquatic animal health domain. In particular, the consultation has the following objectives:

(i) To review best practices for GIS applications;
(ii) To review the available geographically related databases and evaluate their potential use;
(iii) To identify and describe functions and methods that can be used in GIS applications;
(iv) To define a novel approach to develop GIS applications, one that can integrate the new technological capabilities.

By gathering information through this consultation, we hope to facilitate the use of state-of-the-art aquatic GIS applications and data reuse, sharing, integration, and comparison across different organizations and GIS users. This will encourage a conscious and informed usage of GIS tools and methods for spatial analysis, ultimately assisting GIS users in planning effective GIS solutions.

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